



Flanders
State of the Art

Development of a landfill mining policy in Flanders (Belgium).

An introduction to ELFM².

Eddy WILLE, geologist – senior advisor
OVAM (Public Waste Agency of Flanders)

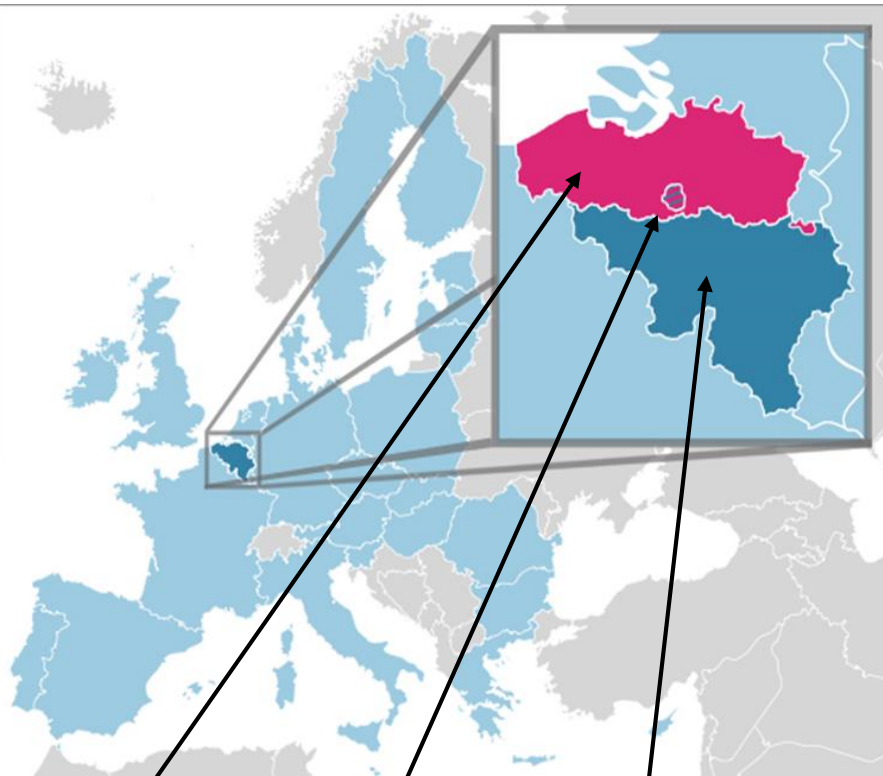
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Outline of the presentation

- ▶ Introduction to Flanders and OVAM
- ▶ Waste management and landfills in Flanders
- ▶ Frameworks and trends
- ▶ Transition from Waste to Sustainable Resource Management
- ▶ ELFM²: Enhanced Landfill Management & Mining

Flanders



General information :

- Population : 6,4 M inhabitants
- Surface : 13.599 Km²
- Densely populated : 472 inhab./Km²
- Highly industrialised
- Regional policies
- Important harbours (nexus to Germany)
- Limited natural resources

“One of the virtues of Belgium is that its tininess allows you to be anywhere else within an hour or two. It takes a while to get used to the idea that the whole country is effectively a suburb of Brussels.”

From: Neither here nor there - Bill Bryson, p.78



Flanders
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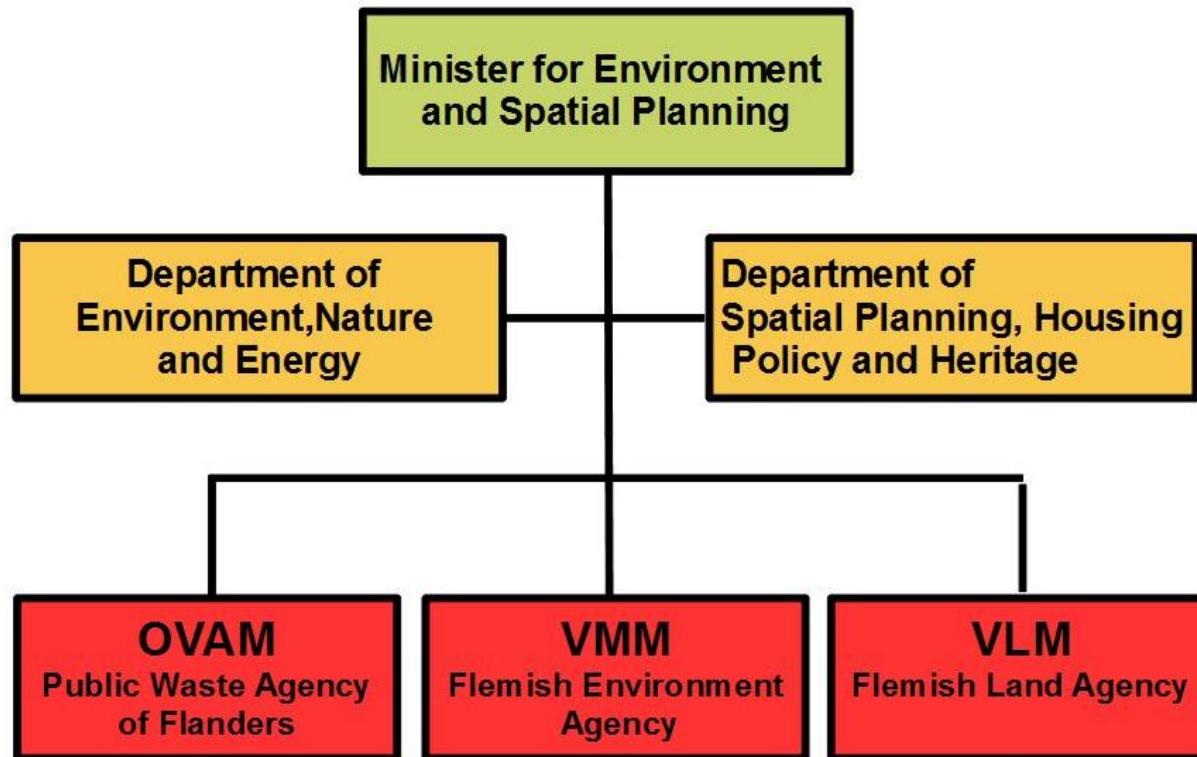
OVAM

OVAM

- Public Waste Agency of Flanders
- Environmental Agency headed by the Flemish Minister of Environmental Affairs
- Established in 1981 (State reform of 1980)
- Competent Authority for:
 - Waste Management;
 - Sustainable Material Management;
 - Soil Remediation.
- Staff: approx. 310 FTE
- Offices : Mechelen – Belgium
- www.ovam.be



OVAM in the environmental policy arena



Tasks of OVAM

To prepare legislation, implement and supervise the implementation of the Flemish legislation on waste management and soil remediation:

- Waste management Act (1981)
- Soil remediation Act (1996)
- Material Management Act (2011)
- ... 2026 ?

The overall goal is to contribute to a better environment and quality of life by:

- ensuring sustainable management of waste and materials
- preventing soil contamination and ensuring soil remediation

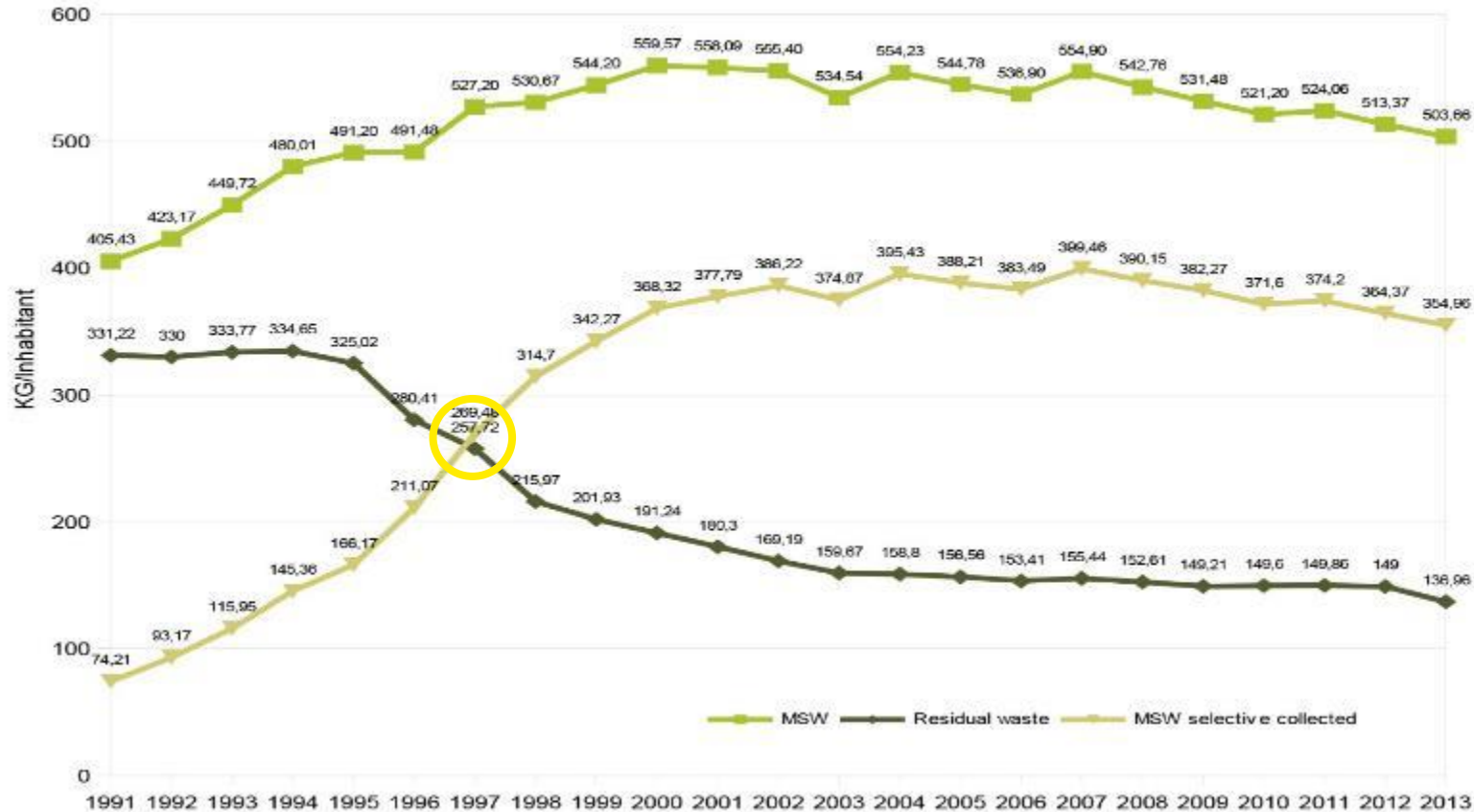
EU : Acts (Directives) on waste, landfills; not on soil contamination /remediation

USA : Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

EPA-mission : to protect human health and the environment

Waste management and landfills in Flanders

Production municipal solid waste (kg/capita): 1991 – 2013



Flanders:
503 kg/inh
(2013)

EU 27:
481 kg/inh.
(2013)

Source: Eurostat
news release
26.03.2015

217 of the 308 municipalities achieved the target of 150kg/inhabitant
71% selective collected



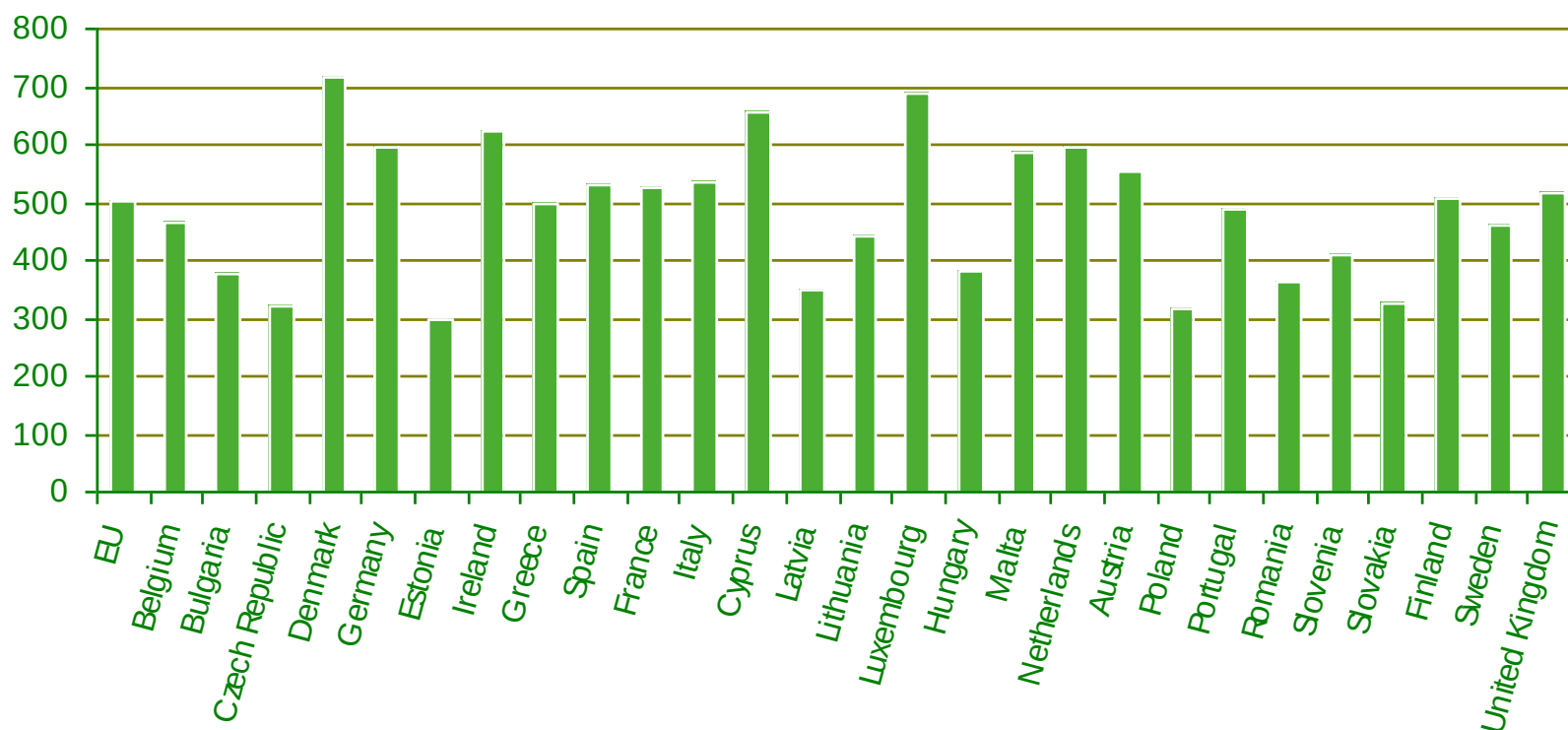
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Waste management



MSW generated - kg per person - 2011

Waste management and landfills in Flanders



Household waste per inhabitant of Flanders

The amount of residual waste we produce is decreasing much more slowly than the waste that is collected separately. Therefore, OVAM wants to improve separate collection even more.

2007

2013

555 KG



503 KG



400 KG



355 KG



(-45 KG)

Collected separately

Collected separately

155 KG



148 KG



(-7 KG)

Residual waste

Residual waste

Contents of the household waste bag



How much food are we wasting?

23 KG



Flemish consumers waste up to 23 kg of food per person each year.

94-142 million kilograms



For Flanders as a whole the amount is between 94 and 142 million kilograms.

With this amount of food 30,000 football teams can be fed for one year.

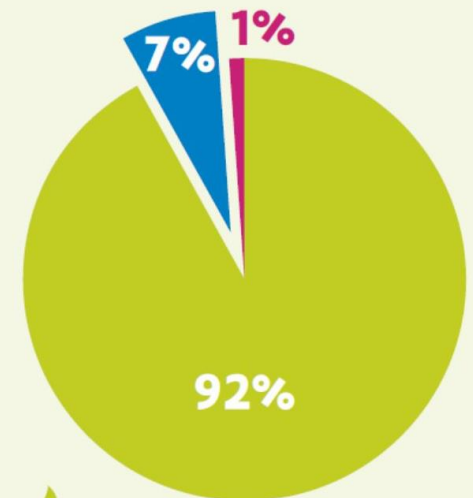


How is residual household waste processed?

950,000 TONNES



This is the amount of non-separated residual waste collected in Flanders each year.



incinerated with energy recuperation



dried or separated



to landfill site

OVAM

Waste management and landfills in Flanders



2012

74%: Reusing, recycling, composting, using as a new material after 2 steps of treatment

11%: Conditioning

10%: Incineration

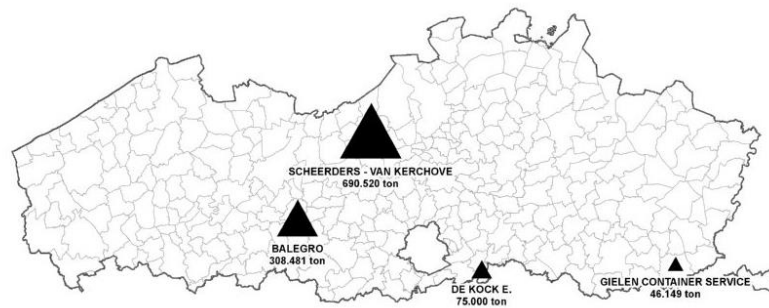
5%: Landfilling

Results: Industrial waste (M tonnes/year): 2004 - 2012

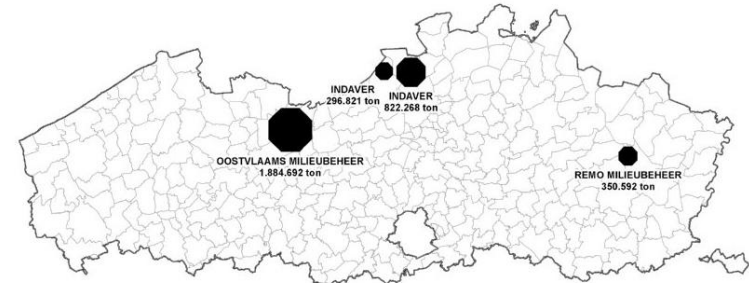
Waste management and landfills in Flanders

Number of landfills

	1985	2015
Cat 1 (Hazardous waste)	11	4
Cat 2 (Non-hazardous waste)	34	9
Cat 3 (Inert waste)	73	4



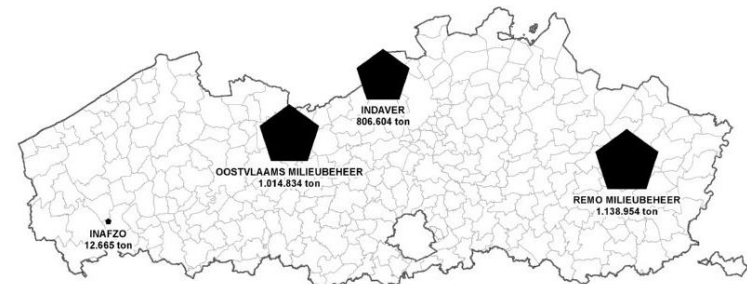
Cat. 3



Cat. 1



Cat. 2 - MSW



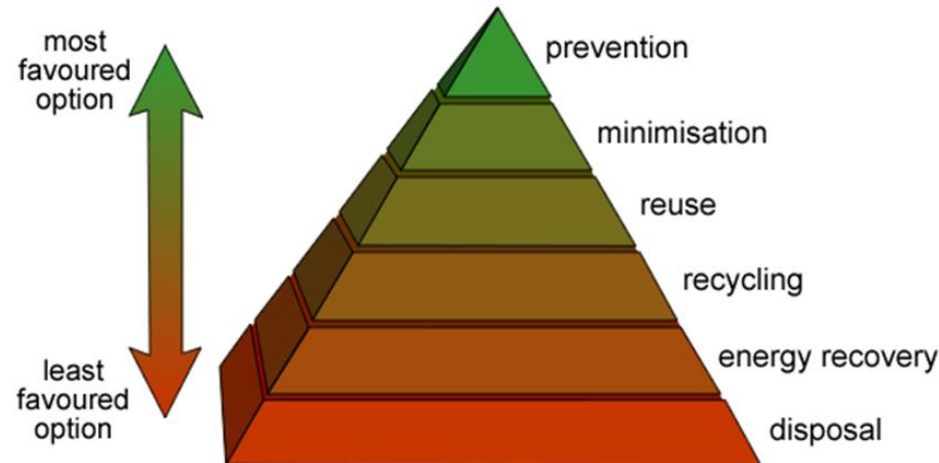
Cat. 2 - industrial

Waste management and landfills in Flanders

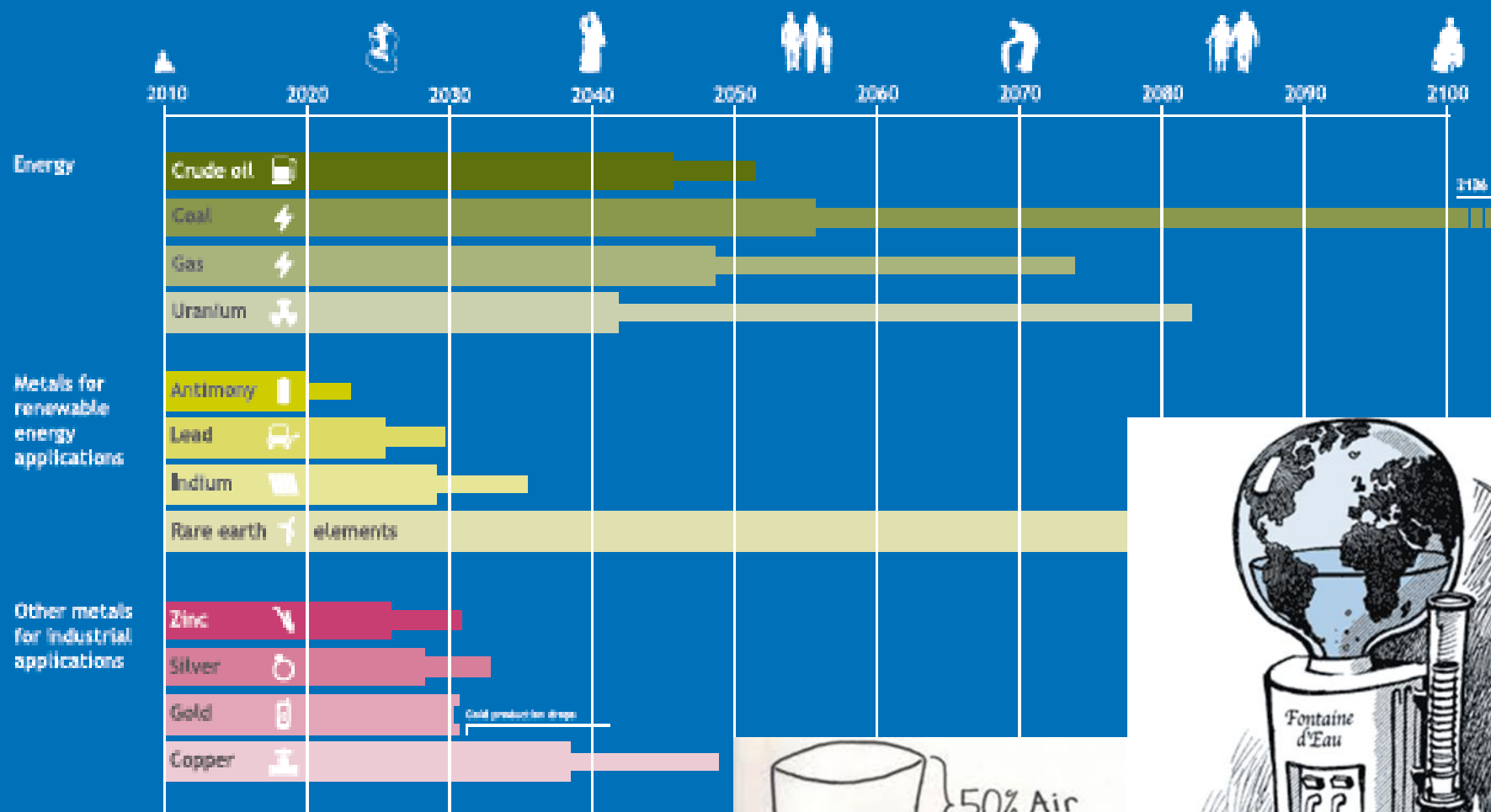
Evolution :



- Waste collection & disposal
- Waste treatment
- Waste hierarchy
- Material management
- Sustainable resource management
- Circular Economy



Born in 2010: How much is left for me?



Remaining years until depletion if production continues to grow at the current rate

Remaining yeast until depletion of production remains constant.

Sponsors: 3M Neophthalic Series, Advel Instruments, World Series of Hotel Facilities, International Export Trade Group, World Wide Travel Center, Inc. (WTC), Tech-Source, Stone Products, World Wide Gas, Appliances, International Lead and Tin, Shark Group, 888-999-9999, Tropicana.



50% Air

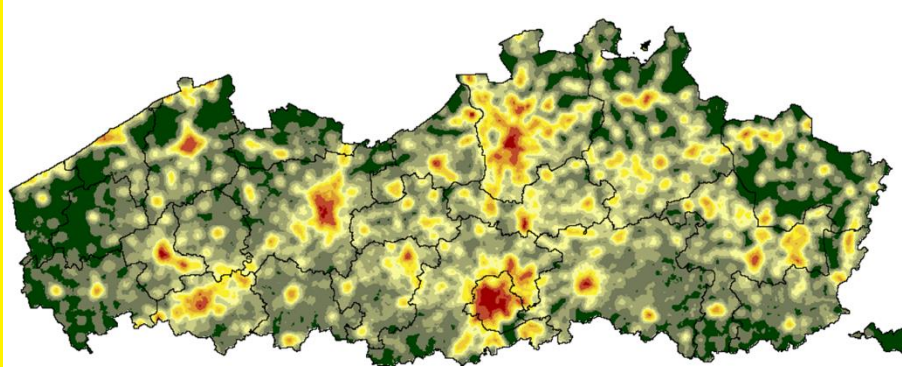
50% Water

Technically,
The Glass is Completely Full.

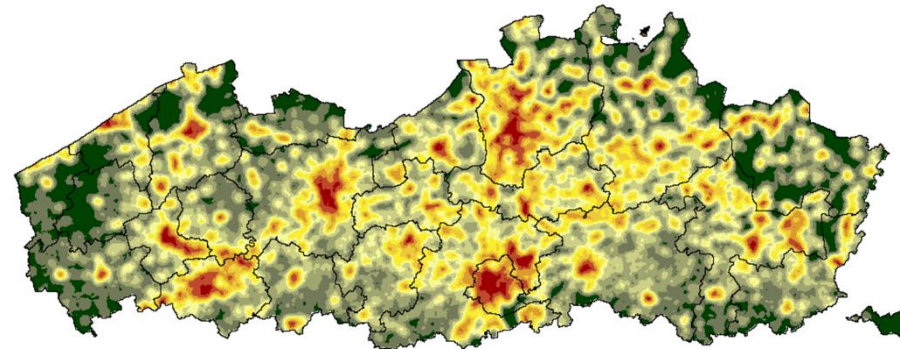


CHAPPATTE

Frameworks and trends



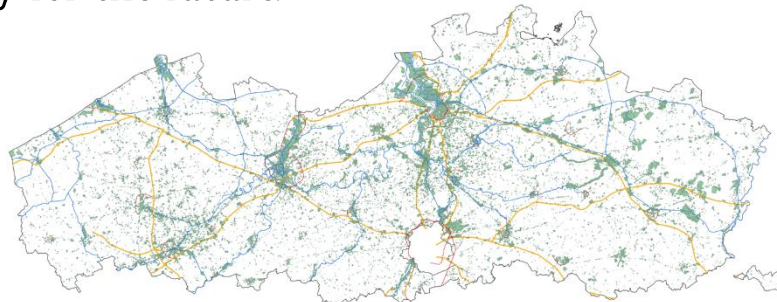
2010



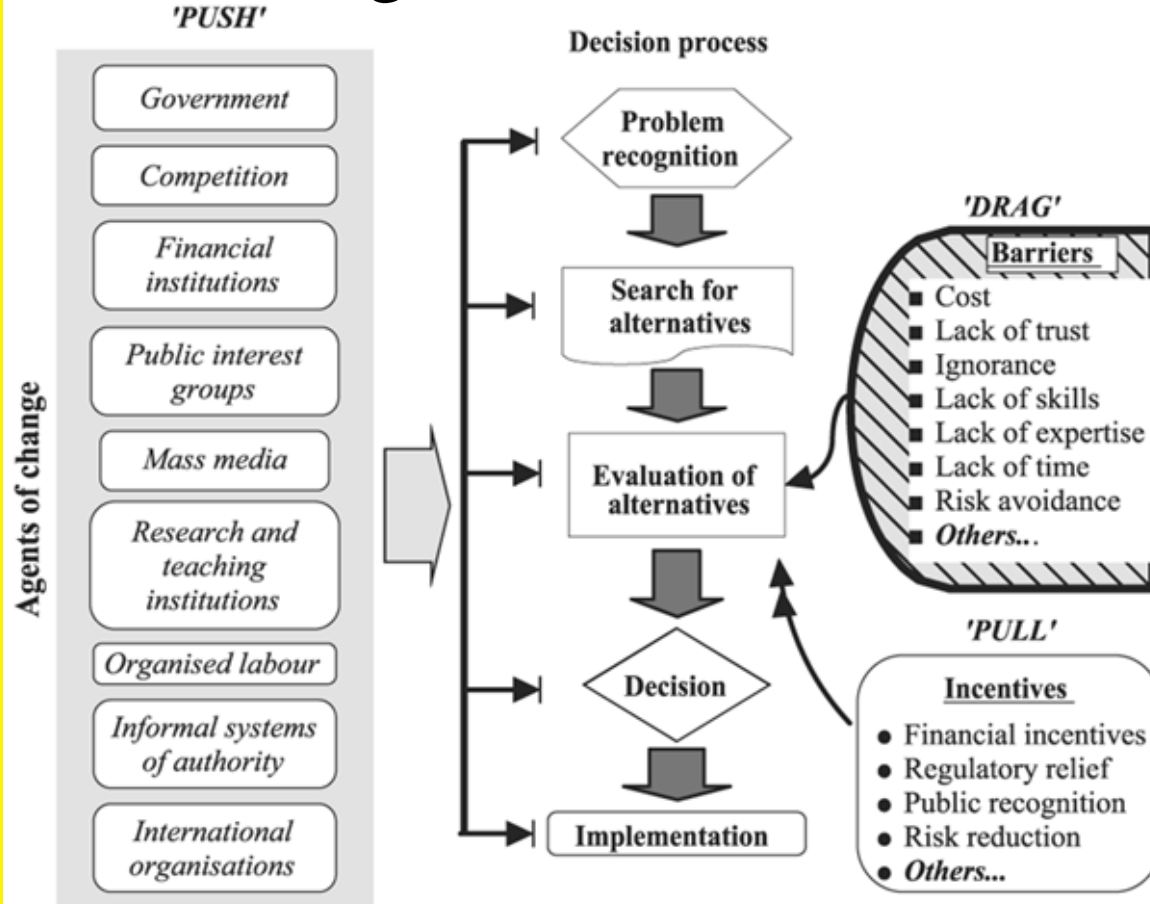
2050

Increase of urban areas in Flanders: in total 7 ha/day; 5 ha/day transformed in residential landuse. Simulation made by Vito for the period 2010 – 2050 shows the impact of urbanisation in Flanders. According to the Planning Agency: population will rise significantly and assessments indicate the need of over 630.000 new dwellings by 2050.

'Ageing cities' is not limited to its inhabitants; infrastructure also requires retrofitting to become more sustainable and ready for the future.



Transition from Waste to Material Management



2.000 landfills (Flanders)
150.000 – 500.000 landfills (EU)

1 – 2 % MSW is landfilled
average 42% is landfilled (EU)

Demands:

- materials;
- energy;
- land;
- drinking water

Options:

- Business as usual;
- Sustainable material management;
- Circular economy

Decision-making framework (Adapted from Yap 1988)

Transition from Waste to Material Management

Our Goals for a Sustainable Material Management :

- ▶ Closing material loops as efficient as possible : circular economy
- ▶ Eco-efficient production
- ▶ Innovation & Ecodesign
- ▶ Stimulate 'Green Consumption'
- ▶ Order in own house : green procurement

Transition : Cradle to grave



Cradle to cradle



Transition from Waste to Material Management

Policy Instruments :

The implementation of the waste policy and strategy requires the use of three different types of policy instruments

- legal instruments (e.g. legislation, penalties, producers responsibility, voluntary agreement, etc ...)
- economical instruments (e.g. levies, taxes, financial support)
- social instruments (e.g. information and awareness raising campaigns, education programs at schools, etc ...)

The challenge is to find the most appropriate instrument or mix of policy instruments to achieve the targets

ELFM – part 1

Policy development & Enhanced Landfill Mining in Flanders :

- OVAM Board of directors (2nd of December 2011). ELFM-research programme 2012 - 2015 approved.
- Government of Flanders Policy agreement 2014-2019. In the approved vision the aspects of circular economy, recycling of landfills and brownfield redevelopment were also confirmed as important policy goals.
- The Policy memorandum of the Minister of Environment (approved on 23rd of October 2014). This memorandum identifies the key strategic choices of her policy for the term of office (2014-2019). The issue of Landfill mining is clearly addressed in this memo and the Minister engaged herself to implement a vision on ELFM as well as on the sustainable stock management of (former) landfills.
- Vision 2050: a long-term strategy for Flanders (approved by Flemish government on 18th of September 2015). Transition to a circular economy and defining the role of landfills and ELFM.

Definition ELFM: Flemish ELFM- Consortium

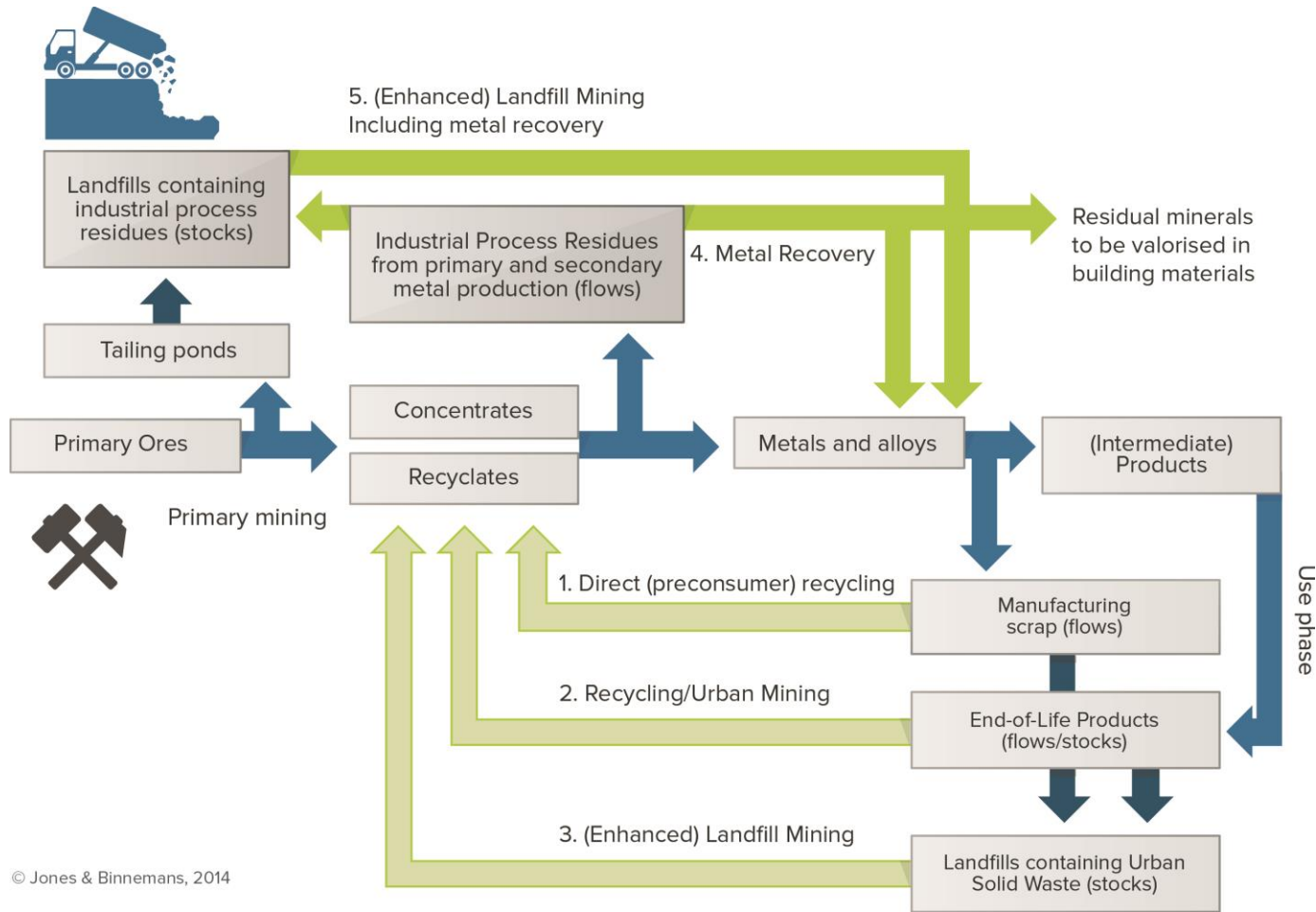
Enhanced Landfill Mining =

“the safe conditioning, excavation and integrated valorization of (historic and/or future) landfilled waste streams as both materials (Waste-to-Material) and energy (Waste-to-Energy), using innovative transformation technologies and respecting the most stringent social and ecological criteria.”

[Enhanced Landfill Mining in view of multiple resource recovery: a critical review](#)



(Enhanced) Landfill Mining within a broader Recycling strategy

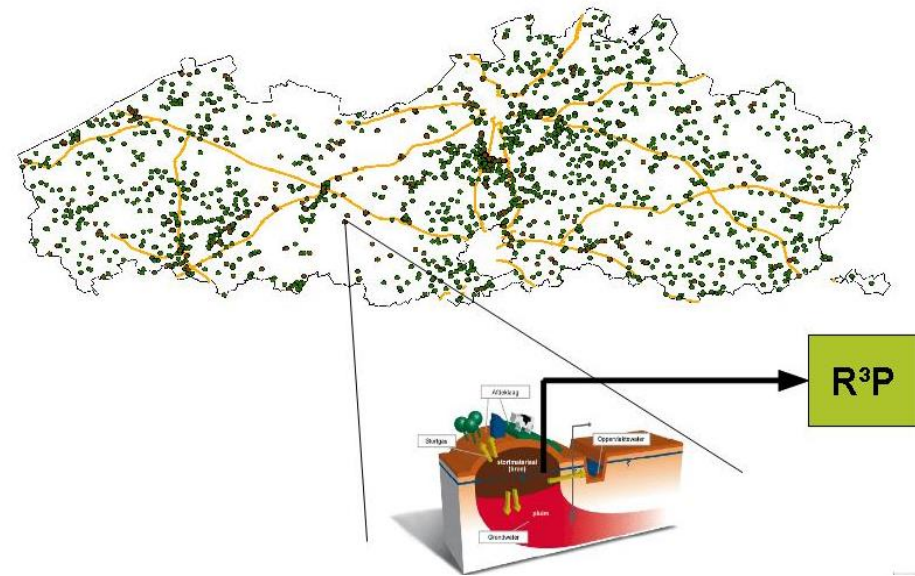


© Jones & Binnemans, 2014

ELFM – part 1

OVAM's Action plan on ELM:

- decision board of directors: dec 2011;
- programme 2012-2015;
- basic principles: Mapping-Surveying-Mining;
- reintroducing Landfills in circular economy;
- developing innovative concepts;
- supporting innovative technologies;
- study on economic and legal aspects;



ICMA SmartBrief

ICMA
Leaders at the Core of Better Communities

Economic Development, Restoration and Sustainability
Wash. city hopes to convert defunct landfill into parkland.

The city of Bellevue, Wash., is moving ahead with plans for transforming a long-closed landfill into Bellevue Airfield Park. Plans include covering the landfill and its methane-extraction system.

ELFM – part 1

Mapping is more than figures of landfills. Identification of stakeholders and ideas matters.

Importance of the governance structure:

4 principles:

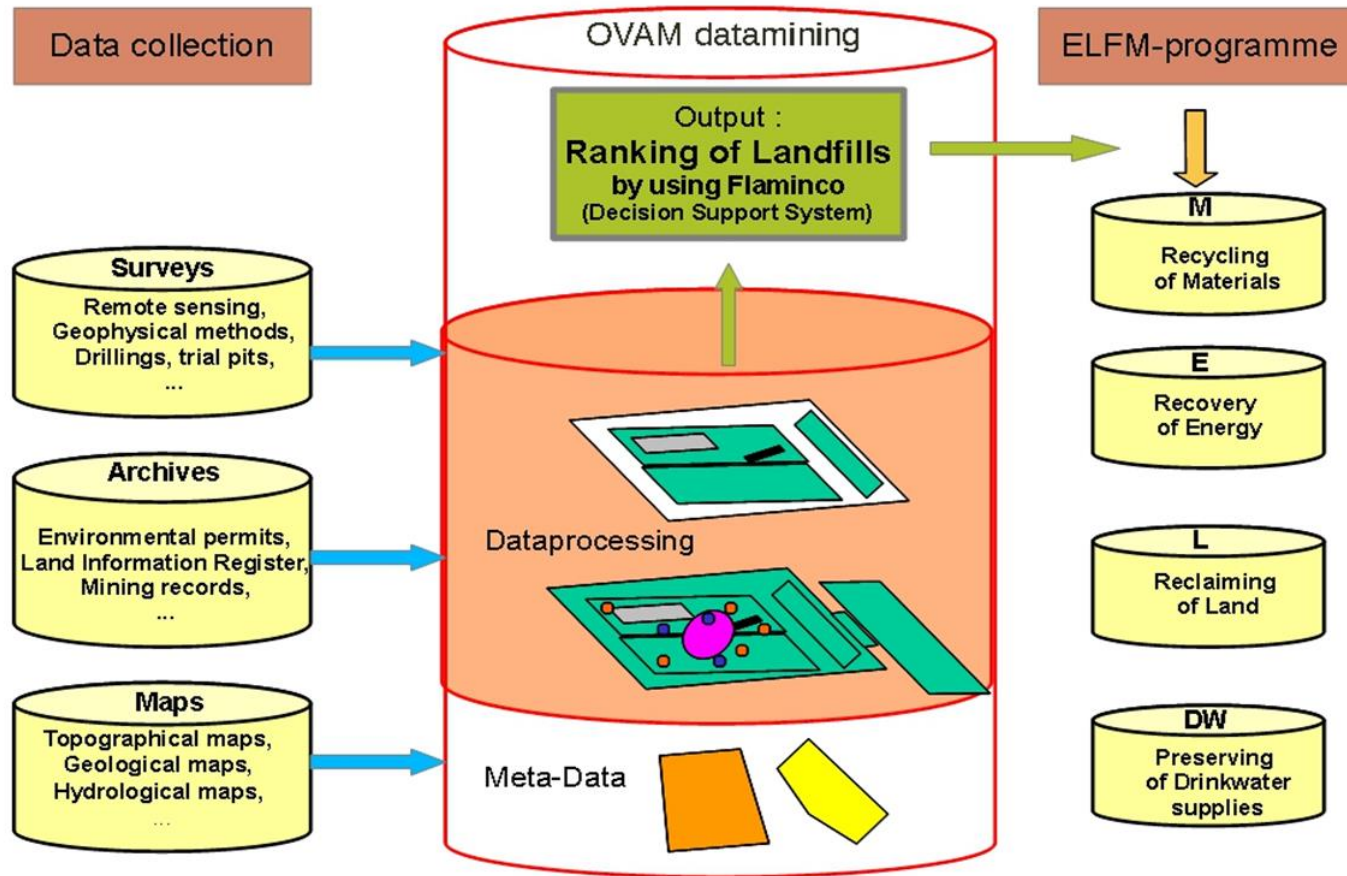
- the use of better evidence for decision making;
- greater engagement and empowerment of citizens;
- thoughtful investments in expertise and skill building;
- closer collaboration with the private and social sectors.

Implementation:

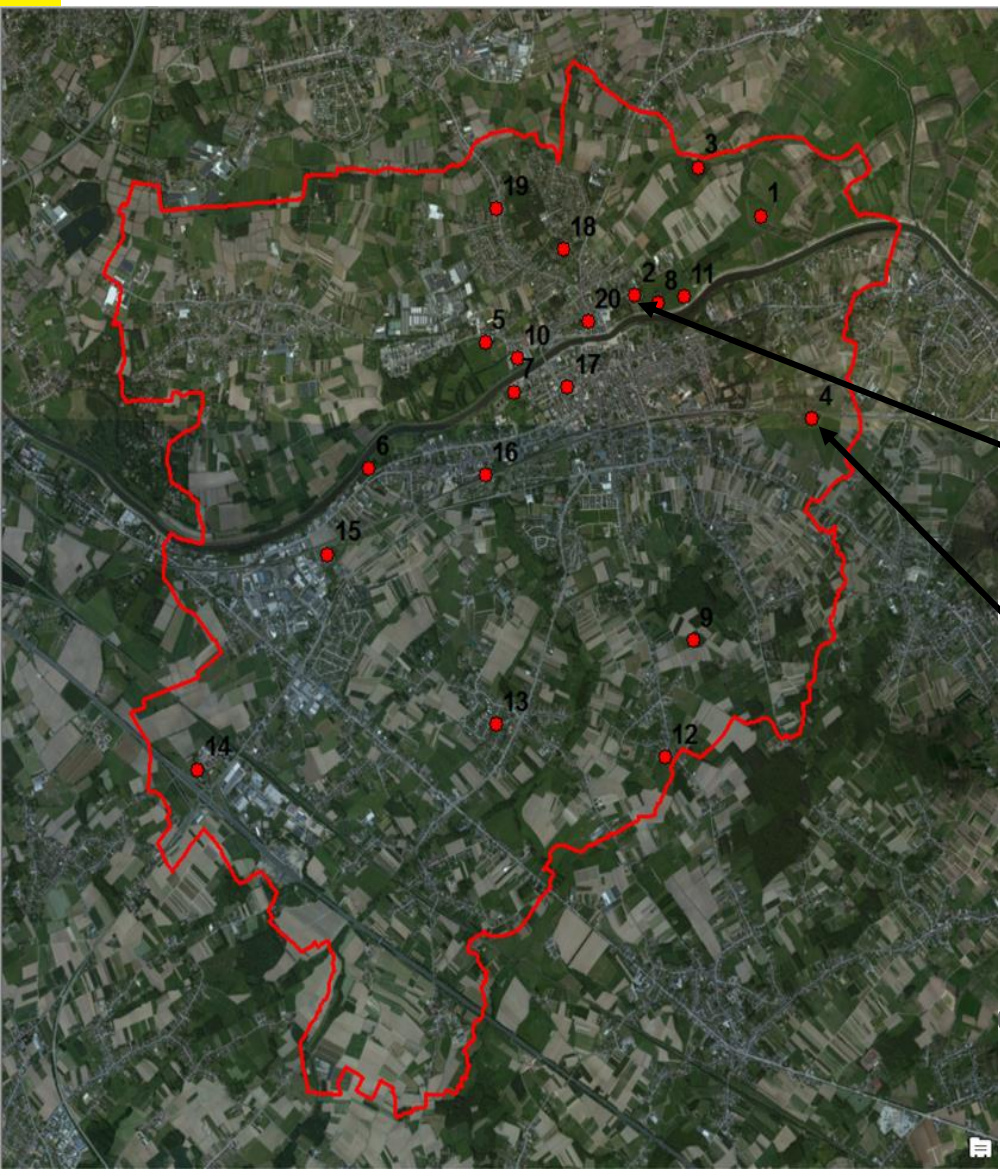
- Multi-actor governance
- Networks:
 - ELFM-consortium Flanders (www.elfm.eu)
 - EURELCO (European Enhanced Landfill Mining Consortium : www.eurelco.org)
- Partnerships: Reclaim



ELFM – part 1



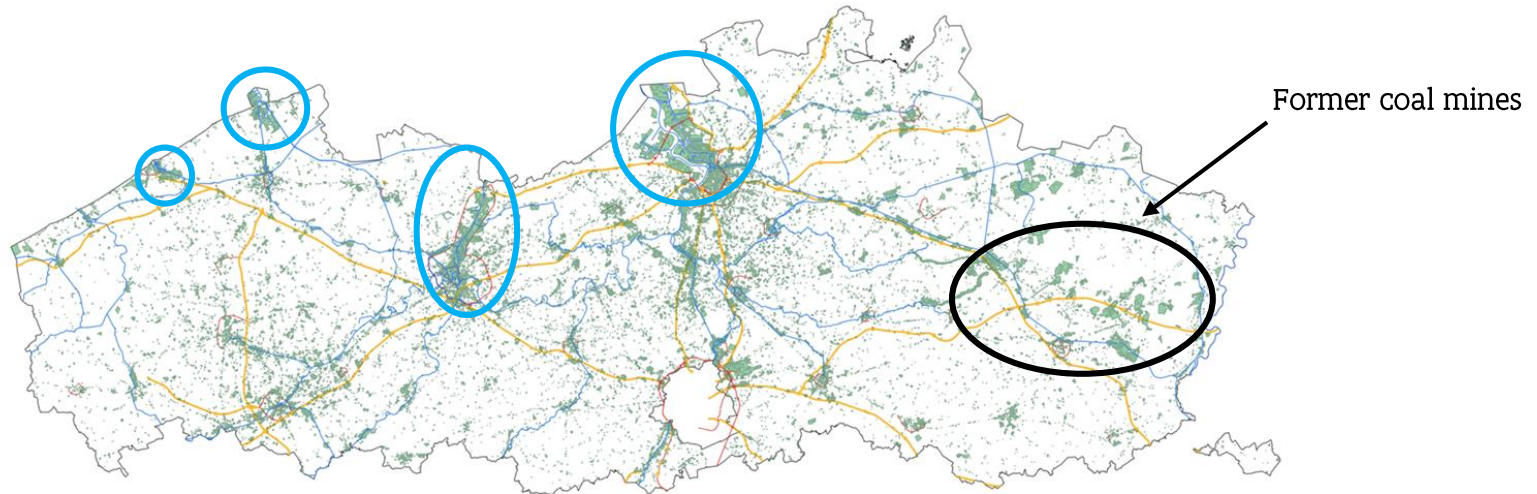
ELFM – part 1



ID	StortplaatsID	Adres	Identific
1	wetteren1	Aaldries	G
2	wetteren2	Kasterstraat	G
3	wetteren3	Peperstraat (grens met Laarne)	G
4	wetteren4	Peyzershoek	G
5	wetteren5	Cooppallaan	G
6	wetteren6	Noordlaan	G
7	wetteren7	Prinses Josephine-Charlottelaan	G
8	wetteren8	Tragelweg	G
9	wetteren9	Langeveldstraat	G
10	wetteren10	Peperstraat	G
11	wetteren11	Tragelweg	G
12	wetteren12	Oordegemsesteenweg	P
13	wetteren13	Prinsenhof	P
14	wetteren14	Oosterzelesteenweg	P
15	wetteren15	Koedreef	P
16	wetter		
17	wetter		
18	wetter		
19	wetter		
20	wetter		



ELFM - part 1

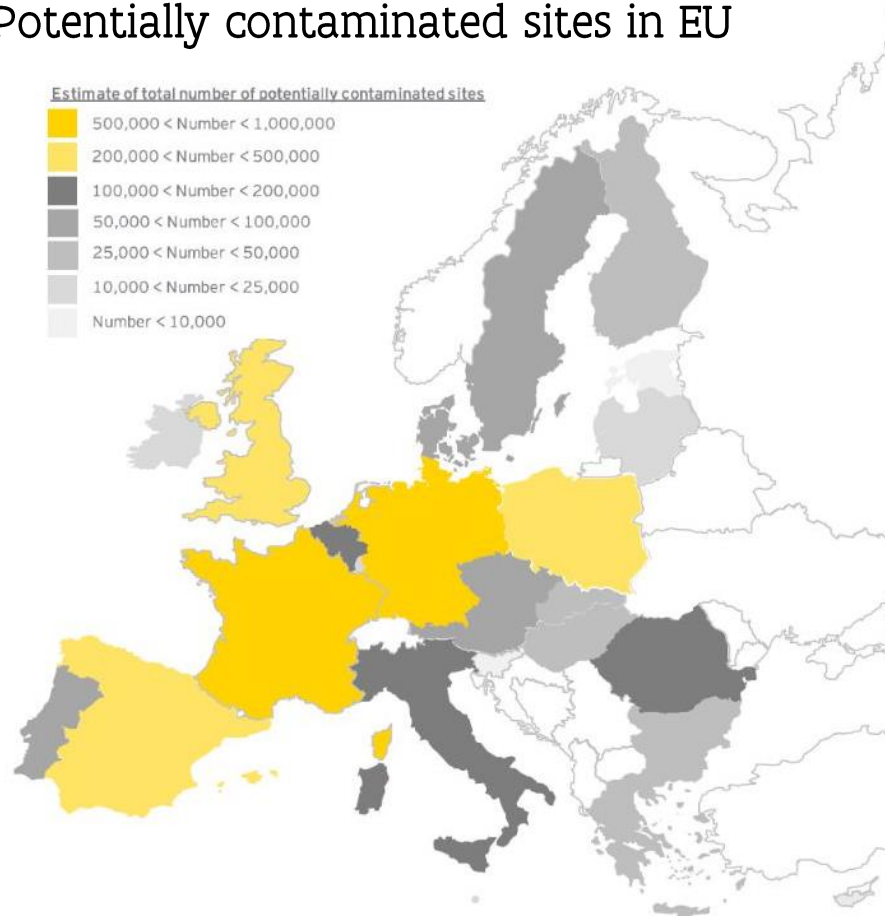


Land Information Register (OVAM) :

- Approx. ca. 34.000 locations investigated; approx. 2.700 remediations completed;
- Estimated risk locations : 85.000 (12.000 sites potentially require remedial actions);
- Links to industrial axes, harbours, mining areas.

ELFM - part 1

Potentially contaminated sites in EU



Estimated number of landfills:

Flanders : 2.000

EU : 150.000 – 500.000 (Hogland)
(100.000 municipalities in EU)

ELFM – part 1

Flaminco (Flanders Landfill Mining, Challenges & Opportunities):
decision support system to manage
landfills in a sustainable way.

2 main components:

- Mining potential;
- Potential environmental impact.

6 criteria to determine EFLM-potential:

- Type of landfill
- Period of landfilling
- Volume of landfill
- Land use of landfill
- Distance to transport modi (roads, waterway, railway)
- Proximity of other landfills

The screenshot shows the FLAMINCO decision support system interface in Microsoft Excel. The interface is divided into several sections:

- Type stortplaats:** A dropdown menu for selecting the landfill type.
- Doelstelling:** A dropdown menu for selecting the objective.
- Criteria:** A section with four criteria, each with a table of weights and uniformity values.
 - Criterium 1:** Weights for different landfill types (WIE, WVM, WVL, RM) are 1.00, 0.50, 0.50, and 0.50 respectively.
 - Criterium 2: Ouderdom:** Weights for different age ranges (1920-1950, 1950-1985, 1985-2100) are 0.25, 1.00, and 0.75 respectively.
 - Criterium 3: Volume:** Weights for different volume ranges (0-100,000, 100,000-500,000, 500,000-1,000,000) are 0.25, 0.75, and 1.00 respectively.
 - Criterium 4: Gebruik:** Weights for different land use types (Aanwezigheid bebouwing, Huidige bestemming, Intermediaire bestemming, Toekomstige bestemming) are 0.8, 0.5, 0.2, and 0.2 respectively.
- Handleiding:** A section providing detailed instructions for each criterion, including 'Type', 'Ouderdom', 'Volume', and 'Gebruik'.
- Beoordeling:** A section at the bottom for evaluating the results.

ELFM – part 1

Surveying:

detailed investigation of the individual landfill site in order to assess the feasibility of ELFM (detailed identification of the landfill: composition of the landfilled waste, identification of the geophysical conditions and -chemical characteristics of the surroundings of the landfill site)

2 case studies at Municipal Waste Disposal sites

Case 1 : 1960s – 1970s; 2,55 ha; average thickness 1,5m

Case 2 : 1970s- 1987; 7 ha; average thickness 10m

University of Ghent tested 5 geophysical methods:

- Electromagnetical induction
- Magnetic method
- Electrical resistivity tomography (ERT)
- Ground Penetrating Radar (GPR)
- Seismic refraction



ELFM – part 1

Mining:

Valorization of the landfill: (pre)treatment of the waste to make it suitable for material reuse or valorization, extracting the waste (in situ/ex situ), valorizing the resources, reclaiming land, eliminating risks and aftercare.

Resources	Extraction method	Products	Pilot
Waste to Materials	Ex situ: excavation	Several	Zuienkerke
	Ex situ: excavation	Coal	Zwartberg
	Ex situ: excavation	FeCl3	confidential
	In situ: leaching	Sulphur	confidential
Waste to Energy	Ex situ: excavation	RDF	Zuienkerke
	In situ: gas extraction	Methane	Several projects
	In situ: solar panel unit	Electricity	Zelzate, Ghent, Heusden-Zolder
Waste to Land	Excavation	Residential area	confidential
	Excavation	Industrial area	Hemiksem
	Excavation	New landfill	Brecht
	Solidification	Salix	Desselgem
	Containment	Recreation	Asse
	Containment/immobilizing	ContainerTerminal	Ghent
	Containment/excavation	Park	Aalst
	Containment/excavation	Water basin	Zaventem
	Containment/excavation	Industrial/recreation	Zwijnaarde

Resource Management version 2.0

Enhanced Landfill Management & Mining (ELFM²)

OVAM, decision Board of directors 18th September 2015:

- Broadening the concept of Enhanced Landfill Mining and introducing long-term management of landfills. Sustainable stock management is the key-issue and stock is defined as the content of the landfills, the surface of the landfills and its impact on the environment. Creating added-value such as materials and energy, beneficial landuse and protection of potable groundwater resources. Interim use as stage in the resource management and mining cycle.
- Concept of ELFM²-memorandum approved and transfered to Minister of Environment.

Resource Management version 2.0

Enhanced Landfill Management & Mining (ELFM²)

Policy aspects :

→ **Transition**

Contribution to sustainable material management :

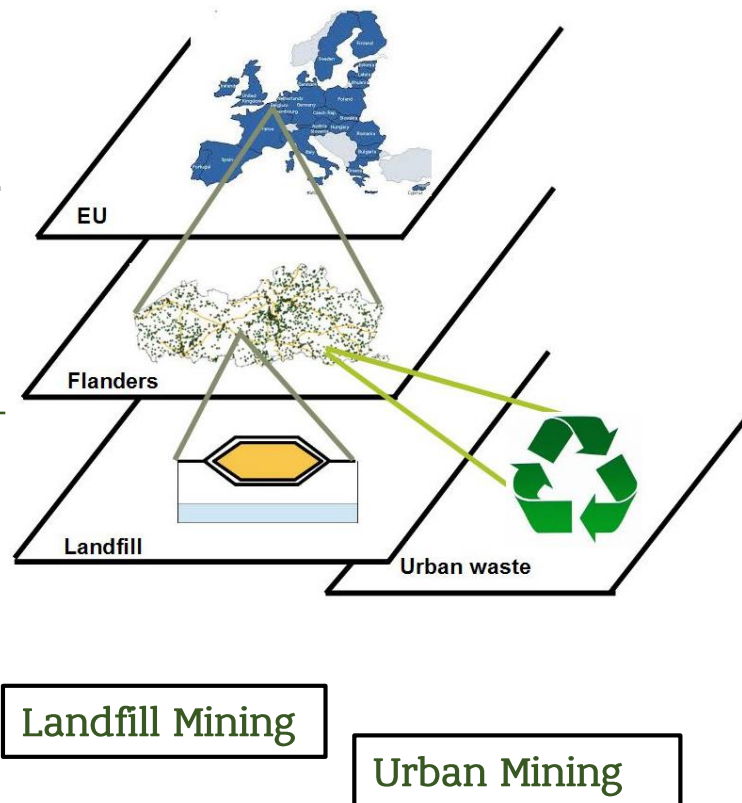
- Resources
- Reserves

Contribution to global well-being :

- Integrated approach
- Governance

Actors :

- Governmental actors
- Civil society



Technological aspects :

→ **Transformation**

Contribution to sustainable materials management:

- Urban Mining
- Landfill Mining

Contribution to global prosperity:

- Added value
- Management

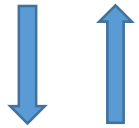
Actors :

- Industry
- Researchers

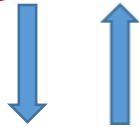
Resource Management version 2.0

Enhanced Landfill Management & Mining (ELFM²)

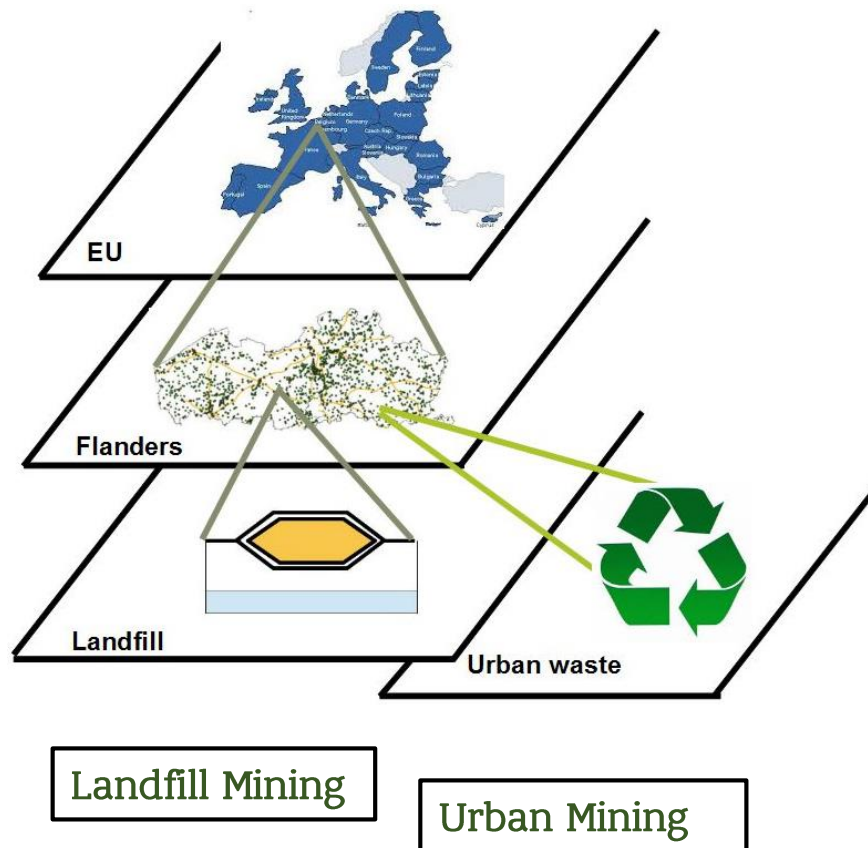
Conceptual
European Model



Conceptual
Regional Model



Conceptual
Site Model



- Analysis of provided information; vision and policy development on waste and sustainable materials management;
- Data aggregation and processing; delivering information on antropogenic resources and reserves;
- Data collection on waste production and landfills.

Resource Management version 2.0

Enhanced Landfill Management & Mining (ELFM²)

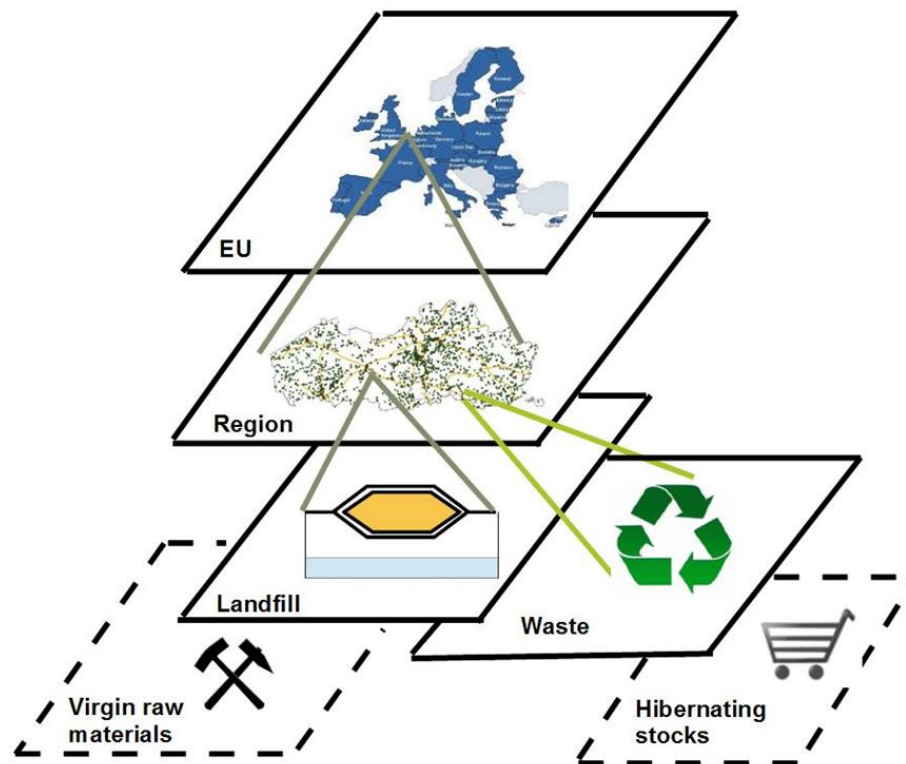
Resource management and
Material flow analysis -
multiple aspect of mining:

Anthropocene era

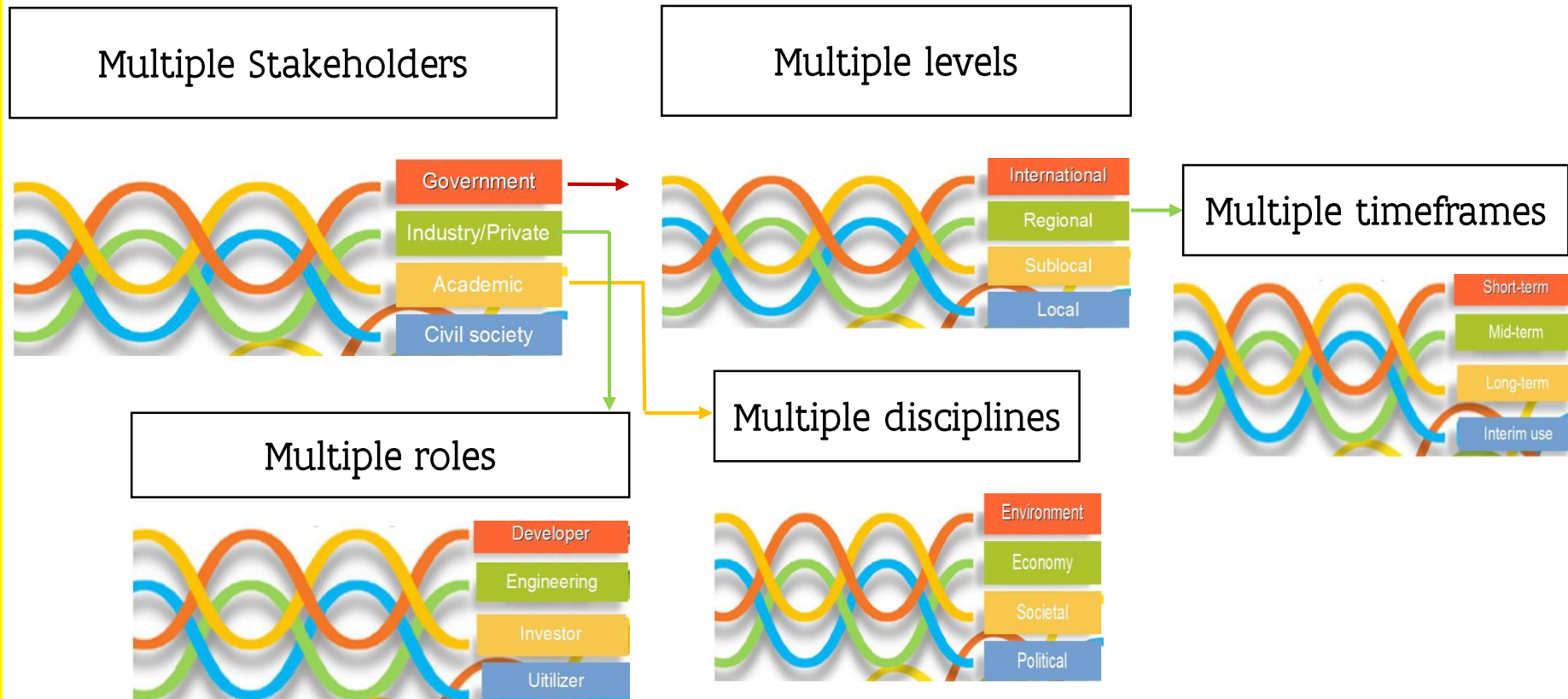
- Urban Mining
- Landfill Mining

All geological era's

- Traditional Mining



Integrated approach and multiple aspects of governance



Participation,(Risk)communication and governance

Specific attention on aspects of communication and governance:

When it comes to judging a risk, most people would rather trust the opinion of a friend than take the word of a scientist.

(new scientist, 28.09.1996)

Roles of the OVAM:



Further contributions on these aspects :

M. Ballard : Local community participation in technological ELFM-projects.

K. Sips : Local community involvement in complex technological projects: challenges for long term planning and dealing with uncertainty.

Thanks for your attention

Eddy WILLE
ewille@ovam.be

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Van de Wiele, Tom Behets, Peter Nagels, Luk
Umans

Government of Flanders
Public Waste Agency
of Flanders
Stationsstraat 110
2800 Mechelen, Belgium
T: 015 284 284
F: 015 203 275
www.ovam.be
info@ovam.be



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